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REMARKS

DETAILED DESCRIPTION OF THE INVENTION

Applicant respectfully submits that the amendment to the Detailed Description of the Invention does not add any new matter since the amendment was performed to correct a typographical error.

OBJECTION TO THE SPECIFICATION

The Applicant stands by the argument previously made with respect to this objection, as was presented in the Response to Office Action dated October 17, 2006. In response to the Examiner's objection, the Applicant fails to see how adherence to a conventional process provides a "new and useful process, machine, manufacture, or composition of matter, or any new useful improvement thereof", as may be referenced in 35 USC § 101. Applicant feels that his use of variables as described in the specification is clear and that he describes a new and useful process of effectively correcting and detecting errors using a multi-stage decoding process when storing data in a media of a storage device.

In section 1 of the Office Action, the Examiner stated that "applicant's parameters 't' and 'k' are described as inevitably being equal to each other (at least according to the equation for the first polynomial in paragraph 0016, where 't' is replaced by 'k'), and are only used after a multiplication by two which factor also lacks any described relation to any code generator polynomial design objective." Applicant respectfully disagrees with this statement because the specification of the Application, for example, states the following:

> "In one embodiment, t=24 or 2t=48. At step 208, the encoder/decoder subsystem generates p(x) as a polynomial of degree 2k, in which its roots are

> consecutive powers of the same primitive element. In one embodiment, k=2 or 2k=4."

As recited in the above passage, t and k are variables that do not necessarily have to be equal to each other. For example, as stated in the above excerpt from the specification of the present Application, t=24 and k=2.

Furthermore, the Examiner states that "applicant's generator polynomial selection process appears to be an artificial and arbitrary breaking up of the conventional process of selecting 2r = (2t + d) or 2t consecutive roots into a two-part process of selecting two consecutively-positioned consecutive sets [of] roots to arrive at r = (2t + d) or r = 2t." Applicant respectfully disagrees with this Examiner's statement. Applicant's use of 2 polynomials is not arbitrary and relates to using a novel "three stage decoding process" as disclosed in page 18 of the present Application. Applicant's generator polynomial is a genuine and novel approach to combining an error correction using polynomial f(x) with an error detection process using polynomial p(x) to yield a generator polynomial g(x) that is used to encode data using a *single* code by way of generating the remainder polynomial r(x), as described in page 17 of the present Application.

> "At step 216, the remainder polynomial, r(x), is generated by dividing C(x) using g(x).. The remainder polynomial, r(x), contains 2(t+k) parity or redundancy terms. Then at step 220, the encoded codeword, C*(x) is generated by appending the 2(t+k) parity or redundancy symbols to the data portion of the codeword, C(x)."

Use of this remainder polynomial (obtained from combining f(x) and p(x) to yield the generator polynomial g(x) and further using g(x) as a divisor for the codeword, C(x)) allows one to employ a three stage decoding process. The three stage decoding process is illustrated in Figures 3A and

3B of the present Application. The three stage decoding process is described in page 18 of the present Application.

> "In one embodiment, the decoding algorithm utilizes a 3 stage decoding process in which 1) a first error correction is performed at the first processing stage using f(x), 2) an error detection check is performed at the second processing stage using p(x), and 3) a second error correction is performed at the third processing stage using g(x)."

As disclosed in the present Application, f(x) and p(x) may be implemented such that the first error correction corrects up to a maximum of t errors where t corresponds to one-half the degree of f(x). The second error correction may be implemented, if the error detection check determines that errors still remain after performing the first error correction, such that the second error correction corrects up to t+k errors where k corresponds to one-half the degree of p(x). Therefore, what is described in the present Application describes a new and useful process and a system to implement that process. As a consequence, Applicant respectfully requests that the Examiner withdraw his objection to the specification.

<u>CLAIMS</u>

CLAIMS 1, 2, 4, 5, 7 AND 10

The Examiner has rejected Claims 1, 2, 4, 5, 7 and 10 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,872,799, issued to Lee et al. (hereinafter, Lee). The Applicant respectfully disagrees with the 102(b) rejection of independent Claim 1 because the Examiner has not shown a teaching of all elements in each of the three clauses of Claim 1. The Examiner comments that "Lee shows (column 8, lines 40-41) an equation for factors of a code generator

polynomial expressed as: $G_1(x) = (x^3+\alpha^0)(x^3+\alpha^1)(x^3+\alpha^2)$ and $G_2(X) = (x+\alpha)$, the first factor containing three consecutive roots and the second factor containing one (consecutive) root." Lines 40-41 of Lee read as follows:

$$G_1(X)=(X^3+1)(X^3+1)(X^3+\alpha^2)X+\alpha^{10}X6+\alpha^{11}X3+\alpha^3$$

$$G_2(X)=(X+\alpha)$$

While the Applicant may agree that $G_1(x)$ and $G_2(X)$ represent polynomials comprising three consecutive roots and one root, respectively, the Applicant respectfully submits that this does not teach what is recited in the method recited in Claim 1. If the Examiner wishes to maintain his rejection to Claim 1, the Applicant respectfully requests that he show a teaching of all the elements in each of the three clauses of independent Claim 1. Applicant respectfully submits that Claim 1 contains patentable subject matter; and as a result, Claim 1 should be allowed. Applicant requests allowance of Claims 2-10 since these claims depend on an allowable Claim 1.

CLAIMS 1, 2 AND 4

The Examiner has rejected Claims 1, 2 and 4 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,465,260, issued to Zook (hereinafter, Zook). The Applicant respectfully disagrees with the 102(b) rejection of independent Claim 1 because the Examiner has not shown a teaching of all elements of each of the three clauses of Claim 1. Examiner's argument states that "Zook describes (column 4, lines 47+) a Reed-Solomon code generator polynomial with v consecutive powers as roots α^{r-v+1} to α^r and a CRC code generator polynomial with k consecutive powers as roots α^{r+1} to α^{r+K}. The combined Reed-Solomon/CRC code is the product of both code generator polynomials." Although Zook describes a Reed-Solomon code generator polynomial and a CRC code generator polynomial with consecutive powers as roots,

the Applicant respectfully submits that column 4, lines 47+ of Zook does not teach all of the elements and/or features that are recited in the three clauses of independent Claim 1. For example, nowhere does Zook teach "generating a first polynomial whose roots comprise one or more powers of a primitive element of a Galois field, said first polynomial capable of being used to perform a first error correction of an encoded codeword, said first error correction correcting up to a first number of errors equal to one-half the degree of said first polynomial" and "generating a product of said first polynomial and said second polynomial to yield a third polynomial, said third polynomial used to generate said encoded codeword, said third polynomial capable of being used to perform a second error correction of said encoded codeword, said second error correction correcting up to a second number of errors equal to one-half the degree of said third polynomial" as recited in the first and third clauses of Claim 1. If the Examiner wishes to maintain his rejection to Claim 1, the Applicant respectfully requests that he show a teaching of all the elements in each of the three clauses of independent Claim 1. Otherwise, Applicant respectfully requests that the Examiner withdraw his rejection and allow Claim 1.

CLAIMS 26, 27, 30 AND 31

The Examiner has rejected Claims 26, 27, 30 and 31 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,363,511, issued to Massoudi et al. (hereinafter, Massoudi). The Applicant maintains the argument previously made with respect to this rejection, as was presented in the Response to Office Action dated October 17, 2006. Independent Claim 26 recites a system to effectively correct and detect errors in a media of a storage device, wherein the system comprises an encoder for generating an encoded codeword that is written onto said

media of said storage device, and a decoder for decoding said encoded codeword that is read from said media of said storage device using at least two processing stages of error correction, wherein a first of said two processing stages is used to correct up to a first number of errors in said encoded codeword and a second of said two processing stages is used to correct up to a sum of said first number plus a second number of errors in said encoded codeword, said first number corresponding to one-half the degree of a first polynomial, said second number corresponding to one-half the degree of a second polynomial. The Examiner states that "Massoudi discloses a decoder (Fig. 4B) for Reed-Solomon product-code codewords, including two stages of correction (410, 414)." The Examiner alleges that Massoudi's row correction stage (410) provides a "first processing stage used to correct a first maximum number of symbol errors in said encoded codeword," that Massoudi's column and EDC syndrome generator stage (412) provides a "second processing stage used to detect symbol errors", and that Massoudi's column correction stage (414) provides a "third processing stage used to correct a second maximum number of symbol errors in said encoded codeword." However, Applicant has been unable to locate the verbiage that substantiates these statements. Applicant respectfully requests the Examiner to specifically point out where within Massoudi there is a teaching of all the elements of Claim 26. Applicant references the following passage obtained from Massoudi at col. 6, lines 48-52 regarding element 410:

> "The on-the-fly row correction circuitry 410 receives a data stream of ECC block data in rows and detects and corrects row errors on the fly up to a number of errors, which is programmable by a user."

Furthermore, Applicant references the following passage from Massoudi at col. 6, lines 63-66 regarding element 414:

> "The column and EDC syndrome generator circuitry 412 computes syndromes for all columns and also determines all the syndromes for EDC of each of the sectors in an ECC block."

Applicant respectfully submits that the Examiner's cited passages do not teach or disclose what is recited in the second clause of independent Claim 26. For example, elements 410, 414 of Figure 4B of Massoudi does not disclose "a decoder for decoding said encoded codeword that is read from said media of said storage device using at least two processing stages of error correction, wherein a first of said two processing stages is used to correct up to a first number of errors in said encoded codeword and a second of said two processing stages is used to correct up to a sum of said first number plus a second number of errors in said encoded codeword, said first number corresponding to one-half the degree of a first polynomial, said second number corresponding to one-half the degree of a second polynomial", as recited in the second clause of independent Claim 26. Applicant does not see how an On-The-Fly Row Correction Circuitry 410 and a Column Correction Circuitry 414 teaches what is recited in the second clause of Claim 26. Applicant requests the Examiner to explain how an On-The-Fly Row Correction Circuitry 410 and a Column Correction Circuitry 414 teach the one or more elements of the second clause of Claim 26. For each of the foregoing reasons, Applicant respectfully submits that Claim 26 is allowable and requests that the Examiner withdraw his rejection. Applicants respectfully submit that Claims 27 and 30-31 are also in condition for allowance since they depend on an allowable Claim 26.

CLAIMS 1, 2, 4, 5, 7 AND 10

The Examiner has rejected Claims 1, 2, 4, 5, 7 and 10 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,978,415, issued to Weng (hereinafter, Weng '415). Applicant respectfully disagrees with the Examiner regarding this rejection because the Examiner has not shown a teaching of all of the elements and/or features recited in independent Claim 1. The Examiner has cited column 4, lines 32-40 to show a teaching of what is recited in Claim 1. Lines 32-40 state the following:

> "selecting to use for encoding a polynomial that includes either or both of the factors g1(x) and g2(x). The user can thus select between three polynomials, namely:
>
> $p_1(X)=g_1(x)$;
>
> $p_2(x)=g_2(x)$ and
>
> $p_3(X)=g_1(X) * g_2(X)=g(X)$.
>
> with the polynomial $p_1(x)$ producing s ECC symbols, the polynomial $p_2(x)$ producing (n-k)-s ECC symbols and the polynomial $p_3(x)$ producing n-k ECC symbols."

After reviewing lines 32-40, the Applicant respectfully submits that the Examiner does not show a teaching of what is recited in all three clauses of Claim 1. The above cited passage from Weng '415 does not teach all of what is recited in Claim 1. The above passage simply describes selecting between three polynomials but does not teach "generating a first polynomial whose roots comprise one or more powers of a primitive element of a Galois field, said first polynomial capable of being used to perform a first error correction of an encoded codeword, said first error correction correcting up to a first number of errors equal to one-half the degree of said first polynomial; generating a second polynomial whose roots comprise one or more powers of a

primitive element of said Galois field, said second polynomial capable of being used to perform an error detection check of said encoded codeword; and generating a product of said first polynomial and said second polynomial to yield a third polynomial, said third polynomial used to generate said encoded codeword, said third polynomial capable of being used to perform a second error correction of said encoded codeword, said second error correction correcting up to a second number of errors equal to one-half the degree of said third polynomial," as recited in Claim 1.

CLAIMS 8 AND 9

The Examiner has rejected Claims 8 and 9 under 35 U.S.C. § 103(a) as being unpatentable over Weng '415 in view of U.S. Patent No. 5,948,117, issued to Weng et al. (i.e., Weng '117). The Applicant respectfully submits that because of at least the foregoing arguments presented with respect to Claim 1, Claims 8 and 9 (which depend on Claim 1) are allowable. Because the Examiner has taken Official Notice by stating that "the usefulness of using a Reed-Solomon code defined over $GF(2^{10})$ for encoding data to be stored in magnetic disk drives was well-known at the time the invention was made, the Applicant respectfully traverses the Official Notice.

Applicant has not commented on all the remarks made by the Examiner with respect to these rejections because of the foregoing arguments Applicant has made with respect to independent Claim 1; however, Applicant reserves the right to do so in any future response, should the need arise.

CLAIMS 3 AND 6

The Examiner has rejected Claims 3 and 6 under 35 U.S.C. § 103(a) as being unpatentable over Zook. The Applicant respectfully submits that because of at least the foregoing arguments presented with respect to Claim 1, Claims 3 and 6 (which depend on Claim 1) are allowable. The Examiner has taken Official Notice by stating that "it's well known that a Reed-Solomon code can be designed to correct t errors for values of t including 2t = 48. It would have been obvious to a person having ordinary skill in the art at the time the invention was made to implement Zook's arrangements with a value of v = 48. Such an implementation would have been obvious because it was already well known that a Reed-Solomon code can be designed to correct t errors for values of t including 2t = 48." In response, the Applicant traverses and/or challenges the Examiner's Official Notice.

Applicant has not commented on all the remarks made by the Examiner with respect to these rejections because of the foregoing arguments Applicant has made with respect to independent Claim 1; however, Applicant reserves the right to do so in any future response, should the need arise.

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CONCLUSION

Based on at least the foregoing reasons, the Applicant believes that Claims 1-27 and 30-31 are in condition for allowance. A Notice of Allowance is courteously solicited. Should anything remain in order to place the present application in condition for allowance, or should the Examiner disagree or have any question regarding this submission, the Examiner is kindly invited to contact the undersigned at (312) 775-8246.

The Commissioner is hereby authorized to charge any additional fees or credit any overpayment to the Deposit Account of McAndrews, Held & Malloy, Ltd., Account No. 13-0017.

Dated: April 2, 2007

Respectfully submitted,

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